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Barcelona's science diplomacy: towards an ecosystem-driven internationalization strategy

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Urban innovation ecosystems are set to play a prominent role in the internationalization and governance of big cities. By harboring solid scientific and technological assets and attracting both human and financial capital, they are best suited to become the pivotal actors of effective multi-stakeholder partnerships between the scientific community, public institutions, the private sector and civil society. In 2018, Barcelona's knowledge and innovation ecosystem came together to launch a comprehensive diplomatic strategy to put the city's science and technology at the forefront of global challenges. This paper presents the case study of Barcelona and discuss the opportunities for city-led science diplomacy as a formal, institutionalized practice aimed to reinforcing the insertion of local interests in the international scene while favouring the open interaction between the internal stakeholders involved.

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Introduction

Global cities have gained prominence in academic literature on global governance. Their impact is visible in areas such as climate action (Bulkeley and Castán-Broto, 2013; Barber, 2017), migration (Bauder, 2016), human rights (Grigolo, 2019), industrial policy (Dijkstra et al., 2019) or global health. The city has become the unit of measure for innovation in public policy, thereby reshaping rules, and governance practices, including diplomacy.

An increasing number of cities are defining their strategies for internationalization and defining mechanisms that ensure an integral approach to foreign action (Curtis and Acuto, 2018), effective coordination among the different levels of government operating in international affairs (Kuznetsov, 2015), and adequate organization of its various stakeholders (Cerdà-Bertomeu and Sarabia-Sanchez, 2016), as global perspectives and policies from different regions have become increasingly available to local arenas (Tavares, 2016; Nijman, 2016).

This context overcomes state-based approaches, extending the scope of foreign policy and diplomatic action. Global urban areas become active participants by operationalizing technological and innovation policies, expanding the activity of what global means for local governments. An innovation ecosystem does not emerge as an isolated central-government decision: entrepreneurs and researchers move to cities where universities, venture capital and human capital are found.

Global cities are contributing to realize “plural diplomacies” (Cornago, 2013). Old diplomatic structures and agendas may be not functional in the digital order, characterized by global economic flows, information and communication technologies, globalized labor markets, the start-up scene, or even environmental effects. Global cities pay attention to such transformations and respond in a new form of multilateralism -as city networks- and diplomatic practice. What *global* means for local governments makes sense in a sovereignty free debate, as global cities focus on implementing public policies instead of contesting state-nation configuration or other security issues traditionally related to realism.

Science and technology have become the cornerstones of growth within urban ecosystems, with direct consequences on economic and diplomatic activity. Likewise, science impacts the global projection of cities through values of internationalization, economic openness, innovation and demographic attraction of the so-called creative class (Florida, 2003). In this context, the following research question arises: what features make up the science diplomacy of the city of Barcelona? The hypothesis is as follows: the symbolic capital of the city allows differentiation through science and technology as sources of soft power.

This article sheds light on The Barcelona Science and Technology Diplomacy Hub (SciTech DiploHub), a unique experience on innovation and city diplomacy. The case of Barcelona serves as an example on how a global city can enhance its scientific and technological capacity to face local and global challenges, making use of its innovation ecosystem. The institution and its discourse exemplify new goals and methods in diplomatic action, particularly on the urban level.

The article employs the case study research method, defined as a qualitative small research, based on authors’ fieldnotes, focused on a single phenomenon, and tracing a process linking causes with observed outcomes. Fieldnotes were taken during the design and execution of the project by two of its promoters and executive positions. Since two of the authors were involved in the launching of the project, the fieldnotes were taken during the meetings and gatherings with representatives of the public and private sector. The third author has collected experiences of promoters within various academic and professional activities such as events and

conferences at Fundació Carolina 2018, Diplocat 2019, Fundació Banc Sabadell 2019, ESADE Business School 2020. In these quotes, the third author records explanations, questions from the public, or interventions by the co-authors. They are quotes and data published on the website of the institution under study. The case study research method is commonly used in social sciences to deepen one particular event, and “the goal of a good case study is to both produce knowledge about the case, but also provide some cumulative knowledge about the broader universe of cases” (Lamont, 2015). Regarding the limitations of the research method, authors provide auto-ethnographic account of -their experience. This auto-ethnographic exercise intends not to fall into complacency and, therefore, invites a third external author to counter overconfidence on the organization’s own work. To provide evidence, where data are necessary, authors refer to public information openly distributed and available. The public-private status, promoters and members of the Ecosystem Board of Barcelona SciTech DiploHub are accessible on its website. As a non-profit organization, the information is more easily accessible and protected information is not violated.

Science and technology in city diplomacy

The rise of global cities takes place in parallel to that of the knowledge-based society and the digital economy. They have gained prominence in academic literature as the main driver behind productivity growth within a given territory. Before that, innovation policy was primarily intended to increase national technological competitiveness and spatial implications were considered only implicitly in the distribution of public funding (Boschma, 2005). Cities join the globalization process with the aim of benefiting from the advantages of an open and de-industrialized international economy. Educational services, the financial industry and research-intensive companies do not require factories, but access to knowledge and venture capital to develop market ideas and solutions. It is in this context that cities tap into innovation policies, thereby competing for the attraction of talent and creative classes, access to capital markets and technological expansion.

Science and innovation have both been drivers and followers of the globalization of cities and urban areas. Digital transformation reinforced the urban concentration, as complex economic system needs scale economies in investments, R&D, multimodal transports, access to banking and financial services, and other inputs. Global cities are those which concentrate production, population, capital markets, technologies and knowledge. Spatial concentration means hubs and clusters connected to the territory, thereby giving rise to the development of cluster economic theory (Porter, 1998; Ketels, 2013, G7, 2017). Network effects enhance the capacity for innovation by enabling people to mobilize resources, find relevant and reliable information quickly, and access appropriate knowledge sources and market outlets. This has led to the development of innovation-oriented regional policies (Ewers and Wettmann, 1980). Barcelona represents a reference case, built upon the symbolic capital of the city, which has harnessed its business and financial strength to articulate a narrative of a “global city”, comparable to the one of Paris, London or Rome among other cities. The organization of the Olympic Games in 1992 itself consolidated the orientation of a service economy aligned with economic globalization.

Hubs are not only based on digital communities of activity, but on policies and institutions: “Complex knowledge, therefore does not travel well through digital communications channels and requires the richness of cities to be properly accumulated” (Balland et al., 2020). The global city is the preferred driver to

capitalize technological capabilities. Universities, colleges, and business schools provide graduates with intensive knowledge and expertise in management. Urban scaling and development economics require innovation, also in policy-making and governance (Roig, 2018).

In this context, cities compete with each other in the global arena for the raising of financial capital, the establishment of companies, the development of infrastructures or the execution of cultural and sports mega-events. The underlying economic logic holds that cities also compete in science and technology. In a hyperconnected system characterized by multimodal transport and digital technologies, the most competitive cities will attract more talent, better services and better cultural and educational resources, thereby increasing productivity. Competition does not consist on attracting industrial investments, but in providing cities with better services to join the geography of technological capitalism and corporate globalization (Taylor, 2012). Barcelona's non-capital status has driven the development of an economic model, which is highly dependent on the incorporation of its competitive assets and attractive into the globalization process. Science, higher education and the provision of cultural services allow to differentiate Barcelona from its competitors and create a particular economic offer.

The economic geography of urban cities has become an important vector of international political action. Opening up national economies to global markets has given cities a competitive role both within the same country and globally (Crescenzi et al., 2020; Leffel and Acuto, 2018). Cities host the headquarters of global corporations, commodity, currency and securities exchanges, producer services organizations, international governmental organizations, global conference centers and international transportation systems. As they grow in economic power, cities outstrip their national networks and demand responsibility in global governance (Acuto and Parnell, 2016; Bäckstrand et al., 2017). This is manifested in the demand for access to sources of power and mechanisms of influence in decision-making (Coll, 2015; Katz and Nowak, 2018; Schragger, 2016).

In order to understand how global cities are actorized, Ljungkvist explores "how the Global City's role in the globalized world is constructed and narrated locally" (2015, p. 2). Global cities are claiming political authority in foreign and security affairs (and not just a role in the globalized economy) on the basis of an emergent urban collective identity. According to Ljungkvist, reflexivity is crucial here: cities start referring to themselves as global cities and interacting with the world through policies and practices developed on behalf of their local societies.

As an example, the explicit withdrawal of some nation states from international cooperation, exemplified by the British decision to leave the European Union (EU) and the "America First" policies of the Trump administration, have propelled cities to take direct action in the international arena. While in the United Kingdom, the London City Hall launched the "London is Open" campaign as a first strategy to maintain close relations with EU neighbors, in the United States more than sixty mayors signed the "Chicago Climate Charter", committing to implement the goals of the Paris Agreement at the municipal level. These actions point to the advent of a multi-scalar global governance system in which cities are taking on some of the roles previously reserved for nation states, ranging from the creation of international policy-making frameworks and advocacy coalitions to formulating and implementing global agendas (Acuto, 2013).

Furthermore, the urban level promotes a flexible multi-stakeholder governance, open to cooperation among business, politics, civic society and higher education institutions. From an urban perspective, local governments around the world are

increasingly interested in sharing best practices on local governance, particularly to encourage new linkages between their jurisdictions and the global environment (Burki et al., 1999; Cabrero Mendoza, 1995; Campbell, 2000). The multilevel governance includes regional and subnational level of government integration of such regional innovation systems in globally operating systems (Cooke, 2002; Koschatzky, 1997; Koschatzky and Sternberg, 2000; Marin and Mayntz, 1991). The literature offers examples in migration policies (Scholten and Pennix, 2016) and climate change (Hale, 2018; van der Heijden, 2019). This new governance models inspire the Ecosystem Board of Barcelona Science and Technology Diplomacy Hub (SciTech DiploHub), which integrates both public and private actors.

The urban voice makes sense in multilateral diplomacy, excluding the sovereignty debate (Rosenau, 1990). The New Urban Agenda—Habitat III elaborated a list of priorities in the international urban demands. The agenda identified five main pillars: (1) Strengthening the role of local governments (2) Commitment to creative solutions and innovative practices (3) Building inclusive alliances and citizen participation (4) Adopting an integrated and sustainable territorial development model, and (5) Monitoring, promoting public information and evaluating the impact of public policies. Cities are core actors for the achievement of the Sustainable Development Goals. Local effectiveness is also a consequence of coordinating activities, investments and decisions in networks of influence. Financing green or blue bonds, transferring technology, and supporting capacity building are opportunities for city collaboration. In the field of Sustainable Development Goals, "The Bellagio cities recognized that collective or coordinated purchasing policies, even among a small network of cities, could shape the market in powerful ways, given the aggregate scale of purchasing" (Pipa, 2019, p. 5). In all these cases, science and technology emerge as the cornerstones of public policies to provide specific, global, and shared solutions with other cities and urban territories.

City networks have also gained traction, with examples such as C40 cities (Davidson et al., 2019), the Global Covenant of Mayors for Climate and Energy or the Interreg program in the EU. The logic of the networks, distributed by themes, affinities and concerns impact. Acuto and Rayner consider that city networks are "formalized organizations with cities as their main members and characterized by reciprocal and established patterns of communication, policy-making and exchange" (2016, p. 1150). It seems there's no need for more networks but leveraging these and other partnerships to focus-oriented goals.

Literature recognizes city diplomacy as the "formal strategy in dealing with other governmental and non-governmental actors on an international stage" (Curtis and Acuto, 2018, p. 1). Cities will be part of the future world politics organization (Schragger, 2016). The broad definition fixes a second theoretical aspect: city diplomacy is flexible in formats and processes, opening avenues for participation. Business sectors, communities, universities, R&D labs, and other non-state actors contribute to the outcomes of city diplomacy, but not to international agreements. Such approach considers city diplomacy outcomes as the aggregate of product/services offered to increase the value for global issues effectively involved in city governance, i.e., according to their appropriate capacity. In the case of the city of Barcelona, its prestigious higher education institutions and cultural services, as well as its long-lasting business tradition, allowed the city to leverage capacity in science and technology. These were assets of the city's international action plan that favored Barcelona's diplomatic profile.

As stated above, in city diplomacy, the outcome is more relevant than international agreements. To understand city diplomacy, this paper establishes three conventional layers.

1. Promotion of the local industry and the internationalization of its economy. We find initiatives dedicated to attracting investments and companies, place branding, the protection of gastronomy, tourism of experiences or traditions. The *start-up nation* discourse today is not based on countries, but on geographical hubs. City networks compete against Silicon Valley to offer better conditions to increase the number and quality of high-tech companies. The expected conclusion is that economy represents a fast-track to understand globalization through urban lenses, and economic statecraft instruments are part of city diplomacy toolbox.
2. Political influence and representation in international organizations. There are different topics and approaches for matters related to climate change, the culture of peace, destination branding, health promotion or the right to decent housing. It is not a question of sovereignty, but of significant opportunity to face real problems by individual actions (cities alone) or in a collective (C40, UCLG) or cooperative manner (public and private initiatives). In traditional diplomacy, the Paris Agreement is an example of this new power architecture, mixing quality data (air pollution) and coordination (accountability) to counteract the effects of climate change.
3. Cultural and identity issues. There are many examples: the commemoration of historical events, linguistic immersion, architecture and landscape or cultural festivals. It is worth highlighting the growing use of memory policies to unite cultures and peoples, not necessarily identified with a State. However, at this point it is necessary to warn about rankings and other tools obsessed with marketing approaches to cultural dimensions of diplomacy. Place branding may be under public policy officers, not under PR strategists. The expected findings are the use of culture to profile the city, leveraging the power to attract people (tourists, investors) and companies.

As a result, the world is facing the rise of a diverse multi-layered scenario in which cities and other non-state actors such as higher education institutions, corporations, research centers, and non-governmental organization (NGOs) are leveraging new intangible currencies, such as innovation, knowledge, and reputation on the adventure of going global while remaining anchored to the domestic matters (Weiss et al., 2013). Cities have the capacity to act globally because of the networked properties of the actors they host (Sassen, 1991; Castells, 1989; Taylor, 2012). This requires a “governance perspective, which acknowledges that multiple actors (public, civil society, and market actors) at multiple levels (from the local to the global) are now involved in governing, often through hybrid constellations that exist next to each other without hierarchical order” (Bouteligier, 2013, p. 13). These stakeholders are often based in innovation ecosystems within urban areas, which allows cities to gain global influence. Cities establish networks, engage in dialog and negotiations, facilitate public diplomacy, share best practices, encourage collaboration between international private and public entities, and ultimately influence world politics.

Within this context, the role of science in global governance is becoming crucial to ensure the effective uptake of high-quality scientific advice by policymakers. The global and scientific nature of these challenges calls out for international cooperation and places science at the forefront (The Royal Society & AAAS, 2010). With a view to the emerging global challenges, an increasing tendency can be observed in regional and urban policy to reject the classical economic promotion approach and move towards the development of soft intangible factors (Landabaso et al.,

2001), including city diplomacy (Acuto, 2013; Glaeser et al., 2010) and science diplomacy (Van Langenhove and Boers, 2018). Cities are joining new collaborative platforms of influence (Tukianen et al., 2015), linking their domestic agendas with universal challenges of sustainability, economic growth and security and opening the door for the development of the aforementioned Urban Agenda. In addition, global challenges from climate change to global health, migrations and food and water security, together with rapid developments in areas such as artificial intelligence, robotics and gene editing require strong cross-border interactions between science, technology and civil society (6th World Science Forum, 2013). As Bulkeley and Betsill (2003, p. 9) explain “urban authorities have a significant but varied role in relation to urban planning, building codes, the provision of transportation and the supply of energy, water, and waste services [...]. Given these powers and their democratic mandate as the local level of government, municipalities can, therefore, be seen as in a position to address the challenges of mitigating and adapting to climate change”.

However, recent literature does not support the idea that cities will become the main actor in the fight against climate change due to its own inability to impose the legislative agenda on the national scale. City networks are powerful diplomatic actors, but they are still in the process of maturation to occupy the space reserved for states (Johnson, 2018; Smeds and Acuto, 2018). Both contributions on city diplomacy and cities in climate action appear to lack a clear contextualization of urban agency in relation to the role of globalizing national states—relations that can be considered to take place on a theoretical continuum between full antagonism and full cooperation.

In summary, both city diplomacy and science diplomacy, as manifestations of soft power, chart a different course from traditional national diplomacy. They have less structure, less direct influence, and fewer formal tools at their disposal (Nye, 2003; Skolnikoff, 1993; Wagner, 2002). As a result, they operate inside a framework that lends itself more easily to collaborative approaches and cooperation. In this regard, theoretical approaches on ecosystem theory, open innovation and the Triple Helix perspective on university-industry-government relationships have underscored the important role of public policy in facilitating these cooperative linkages between the institutional spheres of academic institutions, industry and government (Carayannis et al., 2018; Engel, 2015; Pique et al., 2018). According to the European Commission (2017), Barcelona stands out as an example of the Triple Helix model, built upon two main pillars: science and international recognition.

Within this theoretical framework, the case study of the Barcelona Science and Technology Diplomacy Hub (SciTech DiploHub) sets an example of how city diplomacy is configured as a formal practice at the crossroads of science, technology and international relations.

SciTech DiploHub, a public-private partnership in charge of deploying Barcelona's science diplomacy

Public and private in science city diplomacy. Barcelona's knowledge and innovation ecosystem came together to launch a comprehensive diplomatic strategy to put the city's science and technology at the forefront of sustainable development and global challenges in 2018. As a result, the Barcelona Science and Technology Diplomacy Hub (SciTech DiploHub) was created as non-profit public-private partnership backed by the city's research centers, universities, advocacy groups, start-ups, global corporations and public institutions with the aim to position Barcelona as a global lab in science diplomacy for cities around the world. SciTech

DiploHub has the mandate to elevate the role of science, technology and cities in foreign policy and make Barcelona a more influential player on the global stage by representing its knowledge and innovation ecosystem worldwide (Roig, 2018). The mandate is aligned with the academic literature of globalization and the aspirational desire to become a “superstar city” (Florida, 2003) through scientific and technological specialization. Influence in the technological arena does not depend on past inputs or assets, but can be built through an open ecosystem of executive education, investment and universities that endows scientific projects with an innovative orientation.

The first step towards the creation of Barcelona’s science diplomacy was to identify the key actors in the city’s innovation ecosystem. These included research institutions, higher education institutions, technological parks, scientific infrastructures, tech companies and start-ups, private foundations and public institutions. Higher education institutions are globally recognized, including the Times Higher Education—2019 World University Rankings (5th city of the world with the highest concentration of top 200 universities), the Innovation Cities Index (4th most innovative city in Europe and 21st most innovative city in the world), 5th European hub with most startup capital invested (Atomico dealroom—2018), and the Nature Top Science Cities Ranking 2019 (8th European city and scientific production). In executive education, Barcelona is considered the southern Europe hotspot with 2 business schools in the top 15 in the world, one of which has been ranked #1, according to The Financial Times—2020.

The main challenge encountered during the inception of the project was the lack of alignment of interests, priorities, and actions between the wide range of stakeholders in the ecosystem. It was identified that the internationalization strategies of the main players in the city were fundamentally reactive to competitive pressures such as declining domestic markets or scarce funding, rather than planned, sustainable long-term action plans. Moreover, uncoordinated or overlapping policies at different levels of government were identified as another relevant challenge to overcome. A foundational mission of SciTech DiploHub was thus to reduce thematic dispersion, align interests and priorities, achieve greater coherence with other government levels and dependencies, and build an international cooperation agenda in accordance with the city’s development strategy.

It is critical that from the very outset, the action plan of the city’s diplomatic strategy is arranged in an inclusive manner, taking into consideration the different stakeholders involved, who will necessarily be beneficiaries and active partners of the projects to be developed. The sustainability of a city-led science diplomacy strategy is thus dependant on the degree of legitimacy and acceptance among the local actors involved. These stakeholders seek to develop, within their legal-institutional framework, a series of actions that allow the city to insert itself internationally, thereby becoming international actors. In this regard, the local government is assumed as an interested party at the internal level, while civil society, academic institutions and private companies are external stakeholders and aim to obtain certain benefits of a political, functional, financial and non-financial nature. This strong relationship between the local government (the internally interested party) and the other stakeholders (external stakeholders) ensure that the city’s diplomacy strategy is reflected in the action plans of each of the stakeholders involved, while, in turn, enabling that public policies are in alignment with the stakeholder’s priorities, interests and needs.

In order to be able to specify the instruments required for the insertion of these stakeholders within the city’s diplomatic action,

as well as the potential interactions between them, it is important to conduct a strategic analysis of (i) “how” does the ecosystem want to be internationally perceived and (ii) “where” can the city be recognized as a relevant international partner, while (iii) assessing the competitive landscape and the international positioning of other global cities. The need for a global shared strategy is also driven by the necessity of a better governance. Good governance is characterized primarily by participation, transparency, inclusion and equity (UNESCAP, 2006). Gathering all stakeholders under the umbrella of science and technology can promote an equal participation of the ecosystem in the elaboration of transparent and efficient policies that will further benefit Barcelona’s knowledge and innovation ecosystem and meet the needs of society while making the best use of common resources.

The launching of SciTech DiploHub, the Barcelona Science and Technology Diplomacy Hub, was supported by the Barcelona Manifesto, which compiled more than two hundred signatories by university deans, research institutions, all former city mayors, government ministers, business leaders and the city’s most prominent scientists and technology experts, both in Barcelona and abroad. All the stakeholders from the ecosystem came together for the first time in a collective effort to launch the project (SciTech DiploHub, 2018). The foundation of the project through public–private collaboration stands out as a substantive novelty in science diplomacy, which is usually imposed through the top-down logic of central governments.

SciTech DiploHub is a non-profit public–private partnership backed by leading research centers, universities, non-profits, start-ups, corporations and public institutions that positions Barcelona as a global lab in science diplomacy for cities around the world. It has the mandate to elevate the role of science, technology and cities in foreign policy and make Barcelona a more influential player on the global stage through its contribution to global challenges. The main specific goals of the organization are (SciTech DiploHub, 2018):

- To consolidate Barcelona as an innovation capital, ready to meet the United Nations Sustainable Development Goals through science and technology (United Nations General Assembly, 2015).
- To position the city as an influential geopolitical actor through science diplomacy. Becoming a reliable partner thus paving the way for other global cities committed to developing their own science and technology diplomacy strategies.
- To promote a sound and inclusive multi-stakeholder dialog to design and deploy Barcelona’s science diplomacy action plan, through partnerships among the scientific community, start-ups, policymakers, NGOs, the diplomatic corps, the private sector and civil society.
- To empower a global network of top scientists and technology experts educated in Barcelona to foster international cooperation, showcase our scientific strengths abroad and help us better understand and interpret key global issues.
- To become a world-class think tank where scientific expertise and innovation can be harnessed in support of an evidence-based local and foreign policy.

SciTech DiploHub implements a comprehensive action plan to deploy Barcelona’s science and technology diplomacy strategy. It brings together consulates, international organizations and the city’s innovation ecosystem to enhance collaborative projects; empowers the global diaspora of scientists and technology experts educated in Barcelona, the Barcelona Alumni network, and organizes international events to connect the city’s ecosystem

with other global hotspots in science and technology. In addition, it offers capacity building and training in science diplomacy for city officers and diplomats; delivers policy advice for local city councils and partners with other international organizations, working as a think tank where scientific expertise can be harnessed in support of evidence-based policy (SciTech DiploHub, 2018). The following section will discuss two of the main initiatives of Barcelona's science diplomacy action plan: the Barcelona Alumni Network and The Barcelona Science and Technology Diplomatic Circle. These complementary tools are innovative in terms of soft power, since they articulate communities of interest, empower citizens outside of public institutions and allow dialog between different levels of government (central, regional and local government).

Networking Barcelona influencers. More attention has been paid in recent years to the role of higher education and talent mobility in public diplomacy and the contest for global influence. Some scholars have highlighted the “influence of high-quality human capital, local and global human network, and high-valued intellectual capacity” as elements of soft power in forming “an intangible regional network and leadership position, which will extend its long-term political, cultural, and social impacts in the region and beyond” (Cheng et al., 2011; Mok, 2012; Shields and Edwards, 2010).

Alumni play an important role as key allies and advocates of Barcelona's economic, social and cultural value beyond geographical areas. However, existent Alumni networks from the city's higher education institutions have dedicated minor efforts in establishing an international network of influence and these have been limited mainly to the regional arena. A direct consequence is a low representation and visibility of the city's higher education ecosystem in the international scene.

In this vein, the ecosystem's Alumni were identified as an underexploited crucial element of Barcelona's science diplomacy strategy as intercultural communicators, ambassadors of the city's knowledge ecosystem and education, business and trade promoters, thereby increasing the international recognition and visibility of the city's ecosystem. To untap this potential, the Barcelona Alumni network was launched as the global community of scientists, technology experts, researchers and innovation leaders trained in Barcelona and currently based abroad. The network currently gathers over one thousand members of more than thirty countries (Roig and Jiménez, 2019). Scientific specialization allows the emergence of a dynamic community, focused on thematic activities. Scientific dynamism serves as an accelerator of the diplomatic function: shared interests, as an essential characteristic of soft power, promote the development of an agenda of internationalization and influence. Thus, the institution acts as an umbrella organization, but not as a dominant actor in the relations between scientists linked to Barcelona. This structure represents a diplomatic innovation of interest for literature and, more specifically, for the practice of urban diplomacy.

By connecting and dynamizing this network, Barcelona Alumni creates opportunities for academic, scientific, and business partnerships, thus adding value to the ecosystem's research institutions and innovation industries while enhancing the ecosystem's competitiveness and influence. Simultaneously, it helps the Alumni to inform and encourage others to consider Barcelona as a reliable partner in science and technology, as well as promote the city as a reference destination for training and high education. It also enables the development of key talent pools for industry, investment and entrepreneurship that eventually support the economic development of the ecosystem. Finally, the Alumni network seeks to better understand

international trends and strategic markets, allowing Barcelona's ecosystem to anticipate priorities, research programs and public policies.

The Barcelona Science and Technology Diplomatic Circle is a platform developed by SciTech DiploHub and the Barcelona City Council that engages in periodic visits and encounters between the more than one hundred diplomatic missions and international organizations serving Barcelona and leaders representing academia, the government and the private sector, which shape the innovation ecosystem of Barcelona. Heads of missions, counselors, attachés and officers dealing with science, technology and innovation from consulates, embassies and international organizations have the chance to find out new bonds with Barcelona's science and technology landscape, exchange best practices and connect back to their countries.

This initiative creates opportunities for networking and exchange of information, starting scientific collaborations that might be of global interest and enhancing diplomatic ties through science and technology. It also promotes Barcelona as a reference destination for doing research, investing and studying, thus contributing to the city branding and internationalization strategy. The diplomatic circle is partially inspired by analogous initiatives in other global cities, such as the Science and Technology Diplomatic Circle (STDC) in Boston, Singapore, Shanghai and Tokyo, and the Science Diplomats Club (SDC) in Washington. Barcelona leverages a pre-existent model to endow it with its own characteristics and adapt them to the specific context of the city. As with the first four cities, it includes the following elements: a high number of international students, a competitive educational network, investment capital, R&D centers, and a unique symbolic capital. Like Washington, Barcelona hosts a high number of resident scientists linked to the diplomatic and consular network located in the city.

Governance. SciTech DiploHub is a non-profit organization that establishes itself as the bridge linking together the wide array of stakeholders comprising Barcelona's innovation ecosystem, with the purpose of representing its assets and interests abroad and contributing to its internationalization. The participation of the ecosystem's stakeholders is channeled through the so-called “Ecosystem Board”. Members of the Ecosystem Board consist of public and private entities that are mostly non-profit and devoted to the fields of science, technology, innovation and international relations. Currently, SciTech DiploHub has the support of the following entities (Table 1):

The institutions comprising the Ecosystem Board contribute to the realization of SciTech DiploHub's activities through the provision of financial resources. However, not only does the organization receive financial support from its partner institutions, but it is also granted the position of “ambassador of Barcelona's science and innovation ecosystem” in the international arena. This non-executive position gains relevance in the practice of soft power. The attribution of a status or power of representation, and the diplomatic connotations it encompasses, provides notoriety and uniqueness to the initiative. The ambassador role is novel in the urban domain, especially when referring to the representation of innovation ecosystems, and not to personalities depending on their career or assigned position.

Establishing an inclusive dialog with the urban stakeholders to be involved in the city's internationalization strategy throughout the entire process is a key ingredient for a fruitful public-private collaboration. This entails an effort to raise awareness among the multiple actors about the wide range of assets at their disposal, and therefore allowing them to build on complementarity by utilizing the diverse infrastructures, skills and funding sources.

Table 1 Institutions comprising the Ecosystem Board of SciTech DiploHub—Barcelona Science and Technology Diplomacy Hub.

Entity	Governance	Economy
Barcelona City Council	Public	Non-profit
Barcelona Supercomputing Center (BSC-CNS)	Public	Non-profit
Vall d'Hebron Research Institute (VHIR)	Public	Non-profit
Josep Carreras Leukemia Research Institute (IJC)	Public	Non-profit
Pompeu Fabra University	Public	Non-profit
Open University of Catalonia	Public	Non-profit
La Salle—Ramon Llull University	Private	Non-profit
Biocat—Bioregion of Catalonia	Public	Non-profit
Barcelona Tech City	Private	Non-profit
ACCIÓ-Agency for Business Competitiveness	Public	Non-profit
Fundació Catalunya-La Pedrera	Private	Non-profit
Fundació Banc Sabadell	Private	Non-profit
Fundació La Caixa	Private	Non-profit
Itnig	Private	For-profit
Catalan Foundation for Research and Innovation (FCRI)	Private	Non-profit
Advisory Council for Sustainable Development of Catalonia (CADS)	Public	Non-profit

Communication on a regular basis facilitates the exchange of ideas, information, and perspectives, as well as the mutual understanding of roles and responsibilities to ensure a more efficient decision-making process. A transparent process may contribute to a broader support for the projects under development and set the ground for building mutual trust among the involved partners. Trust is a fundamental element to the commitment of stakeholders, eventually enhancing the cooperative nature of the partnership.

As stated above, one of the main challenges was to align interests between stakeholders. Therefore, a great effort was put on establishing communication channels among all actors with the objective of allowing them to get acquainted with each other. Once the stakeholders have a certain knowledge about their respective interests and conflicts of interests, synergies can be more easily enhanced, and a shared global vision can be designed. In light of the above, SciTech DiploHub emerges as an institutionalized public-private partnership that serves as the pillar structure where public and private stakeholders in Barcelona's innovation ecosystem share and align their interests and missions, thereby converging into the implementation of its science diplomacy strategy and contributing to the city's international projection.

Discussion and conclusions

Urban innovation ecosystems are set to play a prominent role in the internationalization and governance of big cities. By harboring solid scientific and technological assets and attracting both human and financial capital, they are best suited to become the pivotal actors of effective multi-stakeholder partnerships between the scientific community, public institutions, the private sector and civil society. In response to the research question, the Barcelona Science and Technology Diplomacy is characterized by public-private collaboration. The case of Barcelona paves the way for other global innovation ecosystems to explore the opportunities for city-led science diplomacy as a formal, institutionalized practice aimed to reinforce the insertion of local interests in the international scene while favouring the open interaction between the city's internal stakeholders.

The second characteristic is the integration of actors with a strong international orientation. These include not only educational or scientific institutions, but also financial or business organizations. Barcelona's city-led science diplomacy strategy has not only reinforced the international influence of the urban innovation ecosystem but also favored the internal interaction between its main actors by: (i) delimiting the international action of the stakeholders involved, (ii) replacing the tendency towards "reactive internationalization" for a planned, sustainable internationalization strategy; (iii) improving the criteria to prioritize actions and initiatives; (iv) reducing thematic dispersion and aligning interests and priorities; (v) achieving greater coherence with other government levels and dependencies, and (vi) building an international cooperation agenda in accordance with the city's development strategy.

Barcelona's 'niche diplomatic action', focused on science and technology, comprises initiatives such as the Barcelona Alumni Network and The Barcelona Science and Technology Diplomatic Circle, which are true differentiating contributions in the execution of a soft power strategy adapted to cities. Overall, the city of Barcelona has made a substantial effort to adapt its international action to scientific and technological transformations. Knowledge, diplomacy and cities are meant to advance in an intertwined manner, reshaping urban policy planning. In short, Barcelona's case study contributes to understand an initial historical phase, when science and technology met city diplomacy. The designed model confirms the hypothesis of the symbolic capital of Barcelona. The desire for city membership, an esthetic heritage and the recent developments in science and technology, promote a unique style of urban diplomacy.

The very concept of city science diplomacy deserves further discussion. The dawn of this new urban chapter, which links both scientific knowledge and economic activity, will undoubtedly have an impact on global governance, as well as on international institutions and policies related to science and technology. The capacity to lead this new phenomenon will require a coordinated private and public response in accordance with the new multi-layered diplomatic scenario. New capitalism, largely dependent on technological change and continuous innovation, will force cities to compete for R&D facilities, digital infrastructures, and innovation capabilities. Likewise, cities with greater capacity, either individually or within urban networks, will drive territorial inequality. The concentration of capital and talent can sharpen differences among territories and impact economic development, income inequality, or migration. It is not a minor matter. Therefore, city science diplomacy emerges as a relevant field to expand research on global governance.

Data availability

All data generated or analyzed during this study are included in this published article.

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Competing interests

Two authors work at Barcelona Science and Technology Diplomacy Hub, while the third is an international scholar.

Additional information

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